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Public Buildings Enhanced Energy Efficiency Program

Final Report
Investigation Results For
Mesabi Range Community College, Virginia

Date: 6/8/2012

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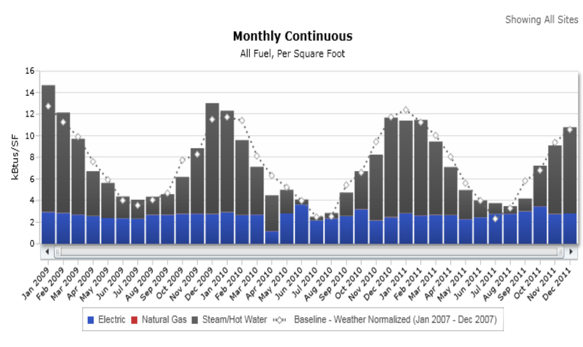
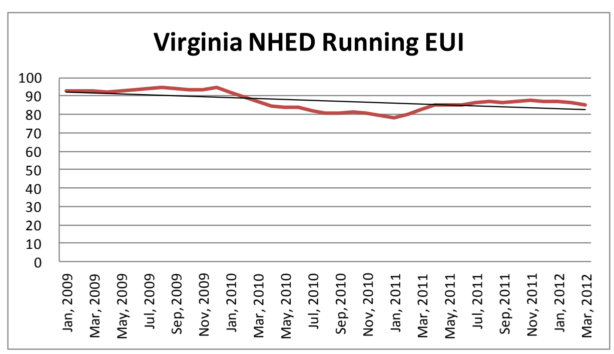
Mesabi Range Community College Energy Investigation Overview

The goal of a PBEEEP Energy Investigation is to identify energy savings opportunities with a payback of fifteen years or less. Particular emphasis is on finding those opportunities that will generate savings with a relatively fast (1 to 5 years) and certain payback. During the investigation phase the provider conducts a rigorous analysis of the building operations. Through observation, targeted functional testing, and analysis of extensive trend and portable logger data, the RCx Provider identifies deficiencies in the operation of the mechanical equipment, lighting, envelope, and related controls. The investigation of Mesabi Range Community College was performed by Karges Faulconbridge, Inc. This report is the result of that information.

Payback Information and Energy Savings				
Total project costs (Without Co-funding)			**Project costs with Co-funding**	
Total costs to date including study	$28,100		Total Project Cost	$41,980
Future costs including Implementation , Measurement & Verification	$13,800		Study and Administrative Cost Paid with ARRA Funds	($30,100)
Total Project Cost	$41,980		Utility Co-funding	$0
			Total costs after co-funding	$11,880
Estimated Annual Total Savings ($)	$16,172		Estimated Annual Total Savings ($)	$16,172
Total Project Payback	2.6		Total Project Payback with co-funding	0.75
Electric Energy Savings	**5.5 %**	**and**	**District Energy Savings**	**9.2 %**





Year	Days	SF	Total kBtu	Normalized Baseline kBtu	Change from Baseline kBtu	% Change	Total Energy Cost $	Average Cost Rate $ /kBtu
2009	365	124,211	11,725,085	11,345,235	379,849	3%	$247,673.14	$0.02
2010	365	124,211	9,858,902	10,564,928	-706,026	-7%	$239,328.64	$0.02
2011	365	124,211	10,803,459	11,124,295	-320,836	-3%	$264,847.36	$0.02

Mesabi Range Community College Consumption Report
Total energy use was unchanged during the period of the investigation

Admin Minnesota STATE OF MINNESOTA B3 BENCHMARKING

Summary Tables

Mesabi Range Community College	
Location	1001 W Chestnut St W, Virginia, MN
Facility Manager	Greg Lamppa
Interior Square Footage	124,211; 122,241 included in investigation
PBEEEP Provider	Karges Faulconbridge, Inc.
Project Manager	Keith Harvey, Director of Finance and Facilities
Annual Energy Cost	$264,847 (2011) Source: B3
Utility Company	Virginia Department of Public Utilities (Electric, Natural Gas, and Steam)
Site Energy Use Index (EUI)	85 kBtu/ft^2 (at start of study) 85 kBtu/ft^2 (at end of study)
Benchmark EUI (from B3)	91 kBtu/ft^2

Building Name	State ID	Square Footage	Year Built
ADA Hallway	E26150C0895	401	1988
Admin, Library, Classroom	E26150C0377	52,739	1977
Arrowhead Office	E26150C0688	3,452	1988
Child Care	E26150C0588	2,859	1988
Classroom/Fine Arts Addition	E26150C0999	6,400	1999
Fine Arts & Commons - Virginia	E26150C0271	28,845	1971
Gym	E26150C0169	18,535	1969
Gym Addition	E26150C0788	7,280	1988
Loading Dock	E26150C0304	1,900	2004

Mechanical Equipment Summary Table (of buildings included in the investigation)	
Quantity	**Equipment Description**
1	Automation System (Honeywell)
10	Buildings
124,211	Interior Square Feet
18	Air Handlers
32	VAV Boxes
1	Steam to Hot Water Heat Exchangers
16	Hot Water Pumps
4	Chilled Water Pumps
1	Cooling Tower
1	Exhaust Fans
580	Approximate number of points for trending

Implementation Information			
Estimated Annual Total Savings ($)			$16,172
Total Estimated Implementation Cost ($)			$11,180
GHG Avoided in U.S Tons (CO2e)			108
Electric Energy Savings (kWh) 5.5 % Savings 2011 Electric Usage 1,160,632 kWh (from B3)			63,415
Electric Demand Savings (Peak kW)			0
District Energy Savings (MMBtu) 9.2 % Savings 2011 Usage 6,677 MMBtu from B3			615
Statistics			
Number of Measures identified			4
Number of Measures with payback < 3 years			3
Screening Start Date	2/22/2011	Screening End Date	8/29/2011
Investigation Start Date	11/3/2011	Investigation End Date	3/02/2012
Final Report	6/8/2012		

Mesabi Range Community College Cost Information		
Phase	**To date**	**Estimated**
Screening	$4,580	
Investigation [Provider]	$21,600	
Investigation [CEE]	$1,920	$1,000
Implementation		$11,880
Implementation [CEE]		$500
Measurement & Verification	0	$500
Total	$28,100	$13,880

Co-funding Summary	
Study and Administrative Cost	$30,100
Utility Co-Funding - Estimated Total ($)	$
Total Co-funding ($)	$30,100

Facility Overview

The energy investigation identified 7.8% of total energy savings at Mesabi Range Community College with measures that payback in less than 15 years and do not adversely affect occupant comfort. The energy savings opportunities identified at Mesabi Range Community College are based on adjusting the schedule of equipment to match actual building occupancy hours, implementing a mixed air temperature reset control sequence to decrease the amount of cold air being brought in to the building during the heating season, repairing a leaking hot water valve, and adding insulation to bare pipes. Additional savings are probably possible, however the building automation system was in the process of being installed for the duration of the four month studies and as a result data was not available from many systems. Based on the number of problems that were found with the automation system installation, that project should be commissioned to insure that Mesabi Range Community College receives the full benefits of the new system. The total cost of implementing all the measures is $11,880.

Implementing all these measures can save the facility approximately $16,172 a year with a combined payback period of 9 months based on the implementation cost only (excluding study and administrative costs). These measures will produce 5.5 % electrical savings and 9.2 % district energy (steam) savings. The campus energy use was unchanged over the period of the study.

The primary energy intensive systems at Mesabi Range Community College are described here:

The Mesabi Range CTC campus consists of 122,411 square feet (sq ft) in nine buildings located in Virginia, MN that are recommended for investigation. There is an exterior garage is not included. The buildings consist primarily of college classrooms.

Mechanical Equipment

Heating Plant

The heat throughout the campus comes from district steam and gets converted to hot water in the U-building. There is a pair of boilers that are used for backup only. The hot water is pumped around the campus using three 10hp, 600 GPM pumps to all buildings on campus.

Cooling Plant

About three quarters of the campus is cooled. The chilled water is produced by a 180 Ton McQuay Centrifugal Chiller with a 10 hp Evapco cooling tower. The chilled water is pumped to the buildings with a single 60 hp, 800 GPM pump. The cooling tower water is pumped by a 10 hp, 690 GPM pump.

Controls and Trending

Two different Building Automation Systems (BAS) were in the process of being consolidated into a single Honeywell system during the study. This project was not completed and many issues were found with the installation while it was in process. It is recommended that this project be commissioned, including testing and balancing if needed, and the building be operated according to its original design conditions.

Lighting

Indoor lighting- Interior lighting primarily consists of T8 32W lights, but some T12 lighting remains. Most classroom lights are operated by a manual switches. The gym has new fluorescent lighting as of this summer.

Outdoor lighting- The outdoor lighting consists of parking lot lighting, side walk lights and some decorative lighting. Some of the lighting is on the BAS and is operated using schedules.

Energy Use Index B3 Benchmark

The site Energy Use Index (EUI) for the building is 85 kBtu/sq ft, which is 7% lower than the B3 Benchmark of 91 kBtu/sq ft. The site EUIs for State of Minnesota buildings are 23% lower than their corresponding B3 Benchmarks on average. This shows the Mesabi Range CTC has potential for improvement.

Metering

The campus has one electrical meter, one steam meter for district steam, and one natural gas meter. There is no submetering at any level on campus.

Findings Summary

Site: NHED Virginia

Eco #	Building	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
1	Virginia Admin, Library	Time of Day enabling is excessive	$1,920	$6,640	0.29	$0	0.29	62
2	Virginia Admin, Library	Supply Air Temperature Reset is not implemented or is sub-optimal	$6,720	$7,696	0.87	$0	0.87	37
4	Virginia Admin, Library	OTHER Maintenance	$2,080	$1,540	1.35	$0	1.35	7
3	Virginia Admin, Library	Leaky/Stuck Valve	$1,160	$295	3.93	$0	3.93	1
		Total for Findings with Payback 3 years or less:	**$10,720**	**$15,876**	**0.68**	**$0**	**0.68**	**106**
		Total for all Findings:	**$11,880**	**$16,172**	**0.73**	**$0**	**0.73**	**108**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

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This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive	YES - All AHU	Trends		
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive			Investigation looked for, but did not find this issue.	
	a.3 (3)	Lighting is on more hours than necessary.			Not Relevant	Not part of scope.
	a.4 (4)	OTHER_Equipment Scheduling/Enabling			Not Relevant	N/A
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)			Not Relevant	Cooling testing not part of scope.
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.	YES - VAV units do not utilize DAT reset.	Trends		
	b.3 (7)	OTHER_Economizer/OA Loads			Investigation looked for, but did not find this issue.	
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive	YES - VAV units do not utilize DAT reset.	Trends		
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement	Yes - large list of BAS failures, but since points were failed, no trend data available. Some points may provide energy savings if corrected, some may just provide proper equipment operation.	Trends/Screen Captures	Not Relevant	There is a large list of BAS point failures; see maintenance list and screen captures for documentation of notes.
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints			Investigation looked for, but did not find this issue.	
	c.4 (11)	OTHER_Controls	YES - VAV units do not utilize DAT reset.	Trends		
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.			Not Relevant	Not part of scope.
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.			Investigation looked for, but did not find this issue.	
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently			Investigation looked for, but did not find this issue.	
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently			Not Relevant	Only one trended point - hw setpoint. Graphics for equipment full of unreliable points.
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary			Investigation looked for, but did not find this issue.	
	d.6 (17)	Other_Controls (Setpoint Changes)			Not Relevant	N/A
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal			Not Relevant	Cooling testing not part of scope.
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal	YES - VAV units do not utilize DAT reset.	Trends		
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal			Not Relevant	Cooling testing not part of scope.
	e.6 (22)	Other_Controls (Reset Schedules)			Not Relevant	N/A
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit			Not Relevant	Not part of scope.
	f.2 (24)	Pump Discharge Throttled			Not cost-effective to investigate	Rebalancing not part of scope of work.
	f.3 (25)	Over-Pumping			Not cost-effective to investigate	Rebalancing not part of scope of work.

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Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
	f.4 (26)	Equipment is oversized for load.			Not cost-effective to investigate	Most of the equipment was fairly new; rely on engineer to properly size equipment.
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction			Not cost-effective to investigate	
g. Variable Frequency Drives (VFD):	**g.1 (28)**	VFD Retrofit - Fans			Not Relevant	Most equipment already had VFDs where it made sense to have variable speed.
	g.2 (29)	VFD Retrofit - Pumps			Not Relevant	Pumps already have VFD.
	g.3 (30)	VFD Retrofit - Motors (process)			Not Relevant	N/A
	g.4 (31)	OTHER_VFD			Not Relevant	N/A
h. Retrofits:	**h.1 (32)**	Retrofit - Motors			Not cost-effective to investigate	
	h.2 (33)	Retrofit - Chillers			Not Relevant	Cooling testing not part of scope.
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)			Not cost-effective to investigate	Most equipment was new, or relatively new and not cost-effective to replace.
	h.4 (35)	Retrofit - Boilers			Not Relevant	Steam to HW heat exchangers.
	h.5 (36)	Retrofit - Packaged Gas fired heating			Not Relevant	HW coils in equipment
	h.6 (37)	Retrofit - Heat Pumps			Not Relevant	Equipment not applicable
	h.7 (38)	Retrofit - Equipment (custom)			Not Relevant	N/A
	h.8 (39)	Retrofit - Pumping distribution method			Not cost-effective to investigate	Rebalancing not part of scope of work.
	h.9 (40)	Retrofit - Energy/Heat Recovery			Not cost-effective to investigate	
	h.10 (41)	Retrofit - System (custom)			Not Relevant	N/A
	h.11 (42)	Retrofit - Efficient Lighting			Not Relevant	Not part of scope.
	h.12 (43)	Retrofit - Building Envelope			Not cost-effective to investigate	
	h.13 (44)	Retrofit - Alternative Energy			Not cost-effective to investigate	
	h.14 (45)	OTHER_Retrofit			Not Relevant	N/A
i. Maintenance Related Problems:	**i.1 (46)**	Differed Maintenance from Recommended/Standard			Investigation looked for, but did not find this issue.	
	i.2 (47)	Impurity/Contamination			Not Relevant	
	i.3 ( )	Leaky/Stuck Damper	Yes - large list of BAS failures, but since points were failed, no trend data available. Some points may provide energy savings if corrected, some may just provide proper equipment operation.	Trends/Screen Captures	Not Relevant	There is a large list of BAS point failures; see maintenance list and screen captures for documentation of notes.
	i.4 ( )	Leaky/Stuck Valve	Yes - AHU-13	Trends/Screen Captures		

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Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
	i.5 (48)	OTHER_Maintenance	Yes - large list of BAS failures, but since points were failed, no trend data available. Some points may provide energy savings if corrected, some may just provide proper equipment operation.	Trends/Screen Captures	Not Relevant	There is a large list of BAS point failures; see maintenance list and screen captures for documentation of notes.
j. OTHER	**j.1 (49)**	OTHER	Yes - Due to the large list of point/BAS failures the system should undergo a full point to point and sequence commissioning process. Also, added some calcs for insulating bare pipe.	Trends/Screen Captures	Not Relevant	There will most likely be a significant energy savings associated with the commissioning of the system due to the large list of point failures, but no way to accurately apply a number to this.

Findings Glossary: Examples of Common Findings Details (Reference)

a.1 (1)	**Time of Day enabling is excessive**
	• HVAC running when building is unoccupied. Equipment schedule doesn't follow building occupancy • Optimum start-stop is not implemented • Controls in hand
a.2 (2)	**Equipment is enabled regardless of need, or such enabling is excessive**
	• Fan runs at 2" static pressure. Lowering pressure to 1.8" does not create comfort problem and the flow is per design. • Supply air temperature and pressure reset: cooling and heating
a.3 (3)	**Lighting is on more hours than necessary**
	• Lighting is on at night when the building is unoccupied • Photocells could be used to control exterior lighting • Lighting controls not calibrated/adjusted properly
a.4 (4)	**OTHER Equipment Scheduling and Enabling**
	• Please contact PBEEEP Project Engineer for approval
b.1 (5)	**Economizer Operation – Inadequate Free Cooling**
	• Economizer is locked out whenever mechanical cooling is enabled (non-integrated economizer) • Economizer linkage is broken • Economizer setpoints could be optimized • Plywood used as the outdoor air control • Damper failed in minimum or closed position
b.2 (6)	**Over-Ventilation**
	• Demand-based ventilation control has been disabled • Outside air damper failed in an open position • Minimum outside air fraction not set to design specifications or occupancy
b.3 (7)	**OTHER Economizer/Outside Air Loads**
	• Please contact PBEEEP Project Engineer for approval
c.1 (8)	**Simultaneous Heating and Cooling is present and excessive**
	• For a given zone, CHW and HW systems are unnecessarily on and running simultaneously • Different setpoints are used for two systems serving a common zone
c.2 (9)	**Sensor / Thermostat needs calibration, relocation / shielding, and/or replacement**
	• OAT temperature is reading 5 degrees high, resulting in loss of useful economizer operation • Zone sensors need to be relocated after tenant improvements • OAT sensor reads high in sunlight
c.3 (10)	**Controls "hunt" / need Loop Tuning or separation of heating/cooling setpoints**
	• CHW valve cycles open and closed • System needs loop tuning – it is cycling between heating and cooling
c.4 (11)	**OTHER Controls**
	• Please contact PBEEEP Project Engineer for approval
d.1 (12)	**Daylighting controls or occupancy sensors need optimization**
	• Existing controls are not functioning or overridden • Light sensors improperly placed or out of calibration
d.2 (13)	**Zone setpoint setup / setback are not implemented or are sub-optimal**
	• The cooling setpoint is 74 ºF 24 hours per day
d.3 (14)	**Fan Speed Doesn't Vary Sufficiently**
	• Fan runs at 2" static pressure. Lowering pressure to 1.8" does not create comfort problem and the flow is per design. • Supply air temperature and pressure reset: cooling and heating

d.4 (15)	**Pump Speed Doesn't Vary Sufficiently**	
		• Pump runs at 15 PSI on peak day. Lowering pressure to 12 does not create comfort problem and the flow is per design. Low ΔT across the chiller during low load conditions.
d.5 (16)	**VAV Box Minimum Flow Setpoint is higher than necessary**	
		• Boxes universally set at 40%, regardless of occupancy. Most boxes can have setpoints lowered and still meet minimum airflow requirements.
d.6 (17)	**Other Controls (Setpoint Changes)**	
		• Please contact PBEEEP Project Engineer for approval
e.1 (18)	**HW Supply Temperature Reset is not implemented or is sub-optimal**	
		• HW supply temperature is a constant 180 ºF. It should be reset based on demand, or decreased by a reset schedule as OAT increases. • DHW Setpoints are constant 24 hours per day
e.2 (19)	**CHW Supply Temperature Reset is not implemented or is sub-optimal**	
		• CHW supply temperature is a constant 42 ºF. It could be reset, based on demand or ambient temperature.
e.3 (20)	**Supply Air Temperature Reset is not implemented or is sub-optimal**	
		• The SAT is constant at 55 ºF. It could be reset to minimize reheat and maximize economizer cooling. The reset should ideally be based on demand (e.g., looking at zone box damper positions), but could also be reset based on OAT.
e.4 ( )	**Supply Duct Static Pressure Reset is not implemented or is suboptimal**	
		• The Duct Static Pressure (DSP) is constant at 1.5" wc. It could be reset to minimize fan energy. The reset should ideally be based on demand (e.g. looking at zone box damper positions), but could also be reset based on OAT.
e.5 (21)	**Condenser Water Temperature Reset is not implemented or is sub-optimal**	
		• CW temperature is constant leaving the tower at 85 ºF. The temperature should be reduced to minimize the total energy use of the chiller and tower. It may be worthwhile to reset based on load and ambient conditions.
e.6 (22)	**Other Controls (Reset Schedules)**	
		• Please contact PBEEEP Project Engineer for approval
f.1 (23)	**Lighting system needs optimization - Spaces are overlit**	
		• Lighting exceeds ASHRAE or IES standard levels for specific space types or tasks
f.2 (24)	**Pump Discharge Throttled**	
		• The discharge valve for the CHW pump is 30% open. The valve should be opened and the impeller size reduced to provide the proper flow without throttling.
f.3 (25)	**Over-Pumping**	
		• Only one CHW pump runs when one chiller is running. However, due to the reduced pressure drop in the common piping, the pump is providing much greater flow than needed.
f.4 (26)	**Equipment is oversized for load**	
		• The equipment cycles unnecessarily • The peak load is much less than the installed equipment capacity

f.5 (27)	**OTHER Equipment Efficiency/Load Reduction**	
		• Please contact PBEEEP Project Engineer for approval
g.1 (28)	**VFD Retrofit Fans**	
		• Fan serves variable flow system, but does not have a VFD. • VFD is in override mode, and was found to be not modulating.
g.2 (29)	**VFD Retrofit - Pumps**	
		• 3-way valves are used to maintain constant flow during low load periods. • Only one CHW pumps runs when one chiller is running. However, due to the reduced pressure drop in the common piping, the pump is providing much greater flow than needed.
g.3 (30)	**VFD Retrofit - Motors (process)**	
		• Motor is constant speed and uses a variable pitch sheave to obtain speed control.
g.4 (31)	**OTHER VFD**	
		• Please contact PBEEEP Project Engineer for approval
h.1 (32)	**Retrofit - Motors**	
		• Efficiency of installed motor is much lower than efficiency of currently available motors
h.2 (33)	**Retrofit - Chillers**	
		• Efficiency of installed chiller is much lower than efficiency of currently available chillers
h.3 (34)	**Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)**	
		• Efficiency of installed air conditioner is much lower than efficiency of currently available air conditioners
h.4 (35)	**Retrofit - Boilers**	
		• Efficiency of installed boiler is much lower than efficiency of currently available boilers
h.5 (36)	**Retrofit - Packaged Gas-fired heating**	
		• Efficiency of installed heaters is much lower than efficiency of currently available heaters
h.6 (37)	**Retrofit - Heat Pumps**	
		• Efficiency of installed heat pump is much lower than efficiency of currently available heat pumps
h.7 (38)	**Retrofit - Equipment (custom)**	
		• Efficiency of installed equipment is much lower than efficiency of currently available equipment
h.8 (39)	**Retrofit - Pumping distribution method**	
		• Current pumping distribution system is inefficient, and could be optimized. • Pump distribution loop can be converted from primary to primary-secondary)
h.9 (40)	**Retrofit - Energy / Heat Recovery**	
		• Energy is not recouped from the exhaust air. • Identification of equipment with higher effectiveness than the current equipment.
h.10 (41)	**Retrofit - System (custom)**	
		• Efficiency of installed system is much lower than efficiency of another type of system
h.11 (42)	**Retrofit - Efficient lighting**	
		• Efficiency of installed lamps, ballasts or fixtures are much lower than efficiency of currently available lamps, ballasts or fixtures.

h.12 (43)	**Retrofit - Building Envelope**	
		• Insulation is missing or insufficient • Window glazing is inadequate • Too much air leakage into / out of the building • Mechanical systems operate during unoccupied periods in extreme weather
h.13 (44)	**Retrofit - Alternative Energy**	
		• Alternative energy strategies, such as passive/active solar, wind, ground sheltered construction or other alternative, can be incorporated into the building design
h.14 (45)	**OTHER Retrofit**	
		• Please contact PBEEEP Project Engineer for approval
i.1 (46)	**Differed Maintenance from Recommended/Standard**	
		• Differed maintenance that results in sub-optimal energy performance. • Examples: Scale buildup on heat exchanger, broken linkages to control actuator missing equipment components, etc.
i.2 (47)	**Impurity/Contamination**	
		• Impurities or contamination of operating fluids that result in sub-optimal performance. Examples include lack of chemical treatment to hot/cold water systems that result in elevated levels of TDS which affect energy efficiency.
i.3 ( )	**Leaky/Stuck Damper**	
		• The outside or return air damper on an AHU is leaking or is not modulating causing the energy use go up because of additional load to the central heating and/or cooling plant.
i.4 ( )	**Leaky/Stuck Valve**	
		• The heating or cooling coil valve on an AHU is leaking or is not modulating causing the energy use go up because of additional load to the central heating and/or cooling plant.
i.5 (48)	**OTHER Maintenance**	
		• Please contact PBEEEP Project Engineer for approval
j.1 (49)	**OTHER**	
		• Please contact PBEEEP Project Engineer for approval

Findings Summary

Building: Virginia Admin, Library
Site: NHED Virginia

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
1	Time of Day enabling is excessive	$1,920	$6,640	0.29	$0	0.29	62
2	Supply Air Temperature Reset is not implemented or is sub-optimal	$6,720	$7,696	0.87	$0	0.87	37
4	OTHER Maintenance	$2,080	$1,540	1.35	$0	1.35	7
3	Leaky/Stuck Valve	$1,160	$295	3.93	$0	3.93	1
	Total for Findings with Payback 3 years or less:	**$10,720**	**$15,876**	**0.68**	**$0**	**0.68**	**106**
	Total for all Findings:	**$11,880**	**$16,172**	**0.73**	**$0**	**0.73**	**108**

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Findings Details

PBEEEP State Government

Building: Virginia Admin, Library

FWB Number:	15800	Eco Number:	1
Site:	NHED Virginia	Date/Time Created:	5/11/2012

Investigation Finding:	Time of Day enabling is excessive	Date Identified:	2/8/2012
Description of Finding:	The AHU/RTU schedules are far in excess of the school's occupancy schedules as described by the staff. Most of the AHU at the site have no OA brought in. For the handful that do, schedule ventilation savings were calculated are included in this calc.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Time of Day enabling is excessive		

Implementer:	Facility Staff	Benefits:	Reduced motor runtimes and ventilation loads.
Baseline Documentation Method:	Trend Data		
Measure:	Reduce equipment schedules to match that actual occupancy of the spaces.		
Recommendation for Implementation:	Review occupancy requirements for the spaces, as well as potential warm-up times before changing schedules. Schedules to reflect actual occupancy.		
Evidence of Implementation Method:	Trend data (SF VFDspd, DAT, RAT, MAT). Verify the fan follows the applied schedules.		

Annual Electric Savings (kWh):	63,415	Annual District Energy-Steam Savings (kBtu):	89,810
Estimated Annual kWh Savings ($):	$5,010	Est Annual District Energy-Steam Savings ($):	$1,630
Contractor Cost ($):	$960		
PBEEEP Provider Cost for Implementation Assistance ($):	$960		
Total Estimated Implementation Cost ($):	$1,920		

Estimated Annual Total Savings ($):	$6,640	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.29	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.29	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	62	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	41.1%	Percent of Implementation Costs:	16.2%

Findings Details

Building: Virginia Admin, Library

FWB Number:	15800	Eco Number:	2
Site:	NHED Virginia	Date/Time Created:	5/11/2012

Investigation Finding:	Supply Air Temperature Reset is not implemented or is sub-optimal	Date Identified:	2/8/2012
Description of Finding:	Several units have hard mixed air setpoints; which prevent the DAT setpoints from resetting efficiently. This leads to simultaneous heating/cooling (economizing to hit MAT setpoint, then reheating at zones), and over-ventilation. AHU-2 IR, AHU-2 SS, AHU-3 SC, AHU-7 & AHU-8 and VAV units and Gym AHU-15 is a constant volume unit.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Controls (Reset Schedules)
Finding Type:	Supply Air Temperature Reset is not implemented or is sub-optimal		

Implementer:	BAS Contractor.	Benefits:	Reduced ventilation load. Prevents economizing back down to a lower DAT, only to reheat at zone level.
Baseline Documentation Method:	Trend Data		
Measure:	Implement an adjustment to sequences of operation to allow supply air temperature to reset upwards when all associated zones are heating. Mixed air temp setpoint should track supply air temperature setpoint to operate most efficiently.		
Recommendation for Implementation:	For VAV units, implement an adjustment to sequences of operation to allow supply air temperature to reset upwards to 65 degF when all associated zones are heating. Mixed air temp setpoint should track supply air temperature setpoint to operate most efficiently. Maintain a minimum OA% for constant volume units and allow the MAT to increase above 55 degF to reduce the ventilation load. Because there was no evidence of night setback from the investigation, it is recommended a night setback of 60 degF is implemented for the AHUs. It is also recommended that the new building automation system is commissioned to resolve issues with the new system.		
Evidence of Implementation Method:	Trend data (DAT, RAT, MAT, OA Damper, VAV ZT), Contractor Invoice. Trend systems for a range of OAT temperaturs, especially cold ones to verify the DAT setpoint reset and that the OA damper is controlling to DAT, not MAT. Verify no simultaneous heating and cooling is happening.		

Annual District Energy-Steam Savings (kBtu):	424,048	Contractor Cost ($):	$4,800
Est Annual District Energy-Steam Savings ($):	$7,696	PBEEEP Provider Cost for Implementation Assistance ($):	$1,920
		Total Estimated Implementation Cost ($):	$6,720

Estimated Annual Total Savings ($):	$7,696	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.87	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.87	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	37	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	47.6%	Percent of Implementation Costs:	56.6%

Findings Details

Building: Virginia Admin, Library

FWB Number:	15800	Eco Number:	3
Site:	NHED Virginia	Date/Time Created:	5/11/2012

Investigation Finding:	Leaky/Stuck Valve	Date Identified:	2/8/2012
Description of Finding:	AHU-13 appears to have leaking valve; 8-10F temp rise across coil with valve commanded to 0%.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Maintenance Related Problems
Finding Type:	Leaky/Stuck Valve		

Implementer:	BAS Contractor.	Benefits:	Not wasting heating energy
Baseline Documentation Method:	Trend Data		
Measure:	Repair valve to prevent leakage/bypass		
Recommendation for Implementation:	Verify HW valve and MAT/DAT sensor operations before replacing valve.		
Evidence of Implementation Method:	Trend data (DAT, MAT, HTG Valve), and verify no temperature rise across the coild when SF on and vlave closed. Contractor Invoice.		

Annual District Energy-Steam Savings (kBtu):	16,259	Contractor Cost ($):	$680
Est Annual District Energy-Steam Savings ($):	$295	PBEEEP Provider Cost for Implementation Assistance ($):	$480
		Total Estimated Implementation Cost ($):	$1,160

Estimated Annual Total Savings ($):	$295	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	3.93	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	3.93	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	1	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	1.8%	Percent of Implementation Costs:	9.8%

Findings Details

Building: Virginia Admin, Library

FWB Number:	15800	Eco Number:	4
Site:	NHED Virginia	Date/Time Created:	5/11/2012

Investigation Finding:	OTHER Maintenance	Date Identified:	2/8/2012
Description of Finding:	Missing Pipe Insulation		
Equipment or System(s):	Other	Finding Category:	OTHER
Finding Type:	Other		

Implementer:	Mech Contractor	Benefits:	Reduced energy transfer to/from piping running through building.
Baseline Documentation Method:	Observations		
Measure:	Add insulation to bare pipes		
Recommendation for Implementation:	Add insulation to bare copper and steel pipes in the mechanical room, included the Flash tank, expansion tanks, and heat exchanger. Note that the heat exchanger was insulated only on part of the plate. The sides and aluminum supports were not insulated.		
Evidence of Implementation Method:	Contractor Invoice, pictures of finished insulation.		

Annual District Energy-Steam Savings (kBtu):	84,857	Contractor Cost ($):	$1,600
Est Annual District Energy-Steam Savings ($):	$1,540	PBEEEP Provider Cost for Implementation Assistance ($):	$480
		Total Estimated Implementation Cost ($):	$2,080

Estimated Annual Total Savings ($):	$1,540	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	1.35	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	1.35	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	7	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	9.5%	Percent of Implementation Costs:	17.5%

PBEEEP
State Government

Public Buildings Enhanced Energy Efficiency Program

SCREENING RESULTS FOR MESABI RANGE COMMUNITY COLLEGE VIRGINIA CAMPUS

Admin Minnesota
DEPARTMENT OF ADMINISTRATION

August 26, 2011

Summary Table

Mesabi Range Community and Technical College	
Location	1001 W Chestnut St W, Virginia, MN
Facility Manager	Greg Lamppa
Number of Buildings	10
Interior Square Footage	124,211
PBEEEP Provider	Center for Energy and Environment (Gustav Brändström)
State's Project Manager	Keith Harvey, Provost, NHED
Date Visited	January 22, 2011
Annual Energy Cost (from B3)	$239,329 (2010)
Utility Company	Virginia Department of Public Utilities (Electric, Natural Gas, and Steam)
Site Energy Use Index (from B3)	85.2 kBtu/sq ft (2010)
Benchmark EUI (from B3)	91.2 kBtu/sq ft

Screening Overview

The goal of screening is to select buildings where an in-depth energy investigation can be performed to identify energy savings opportunities that will generate savings with a relatively short (1 to 5 years) and certain payback. The screening of Mesabi Range CTC was performed by the Center for Energy and Environment (CEE) with the assistance of the facility staff. A walk-through was conducted on January 22, 2011 and interviews with the facility staff were carried out to fully explore the status of the energy consuming equipment and their potential for recommissioning. This report is the result of that information.

The Mesabi Range CTC campus consists of 122,411 square feet (sq ft) in nine buildings located in Virginia, MN that are recommended for investigation. There is an exterior garage is not included. The buildings consist primarily of college classrooms.

Recommendation for Investigation

Building Name	State ID	Square Footage	Year Built
ADA Hallway	E26150C0895	401	1988
Admin, Library, Classroom	E26150C0377	52,739	1977
Arrowhead Office	E26150C0688	3,452	1988
Child Care	E26150C0588	2,859	1988
Classroom/Fine Arts Addition	E26150C0999	6,400	1999
Fine Arts & Commons - Virginia	E26150C0271	28,845	1971
Gym	E26150C0169	18,535	1969
Gym Addition	E26150C0788	7,280	1988
Loading Dock	E26150C0304	1,900	2004

Building Overview Section

Mechanical Equipment

Heating Plant

The heat throughout the campus comes from district steam and gets converted to hot water in the U-building. There is a pair of boilers that are used for backup only. The hot water is pumped around the campus using three 10hp, 600 GPM pumps to all buildings on campus.

Cooling Plant

About three quarters of the campus is cooled. The chilled water is produced by a 180 Ton McQuay Centrifugal Chiller with a 10 hp Evapco cooling tower. The chilled water is pumped to the buildings with a single 60 hp, 800 GPM pump. The cooling tower water is pumped by a 10 hp, 690 GPM pump.

Controls and Trending

There are two different Building Automation Systems (BAS) which are in the process of being consolidated into a single system. The Fine Arts building has a Honeywell system; the rest of the campus has a TAC system, but it is in the process of being converted to Honeywell. Both systems are capable of trending.

Lighting

Indoor lighting- Interior lighting primarily consists of T8 32W lights, but some T12 lighting remains. Most classroom lights are operated by a manual switches. The gym has new fluorescent lighting as of this summer.

Outdoor lighting- The outdoor lighting consists of parking lot lighting, side walk lights and some decorative lighting. Some of the lighting is on the BAS and is operated using schedules.

Energy Use Index B3 Benchmark

The site Energy Use Index (EUI) for the building is 86.5 kBtu/sq ft, which is 5% lower than the B3 Benchmark of 91.2 kBtu/sq ft. The site EUIs for State of Minnesota buildings are 23% lower than their corresponding B3 Benchmarks on average. This shows the Mesabi Range CTC might be performing slightly worse than average in the state.

Metering

The campus has one electrical meter, one steam meter for district steam, and one natural gas meter. There is no submetering at any level on campus.

Documentation

The campus blueprints are all collected in the Maintenance office. Most are very old, and not complete.

Occupancy

The class schedule is from 8am to 4pm in general, but there are some night classes that end at 10pm. The HVAC runs 6am to 11:30pm Monday through Friday and 8am to 10pm on Saturdays, which are the hours the buildings are unlocked. The majority of the staff is there from 7am to 4pm. There also a lot of special events in gyms etc that require HVAC operation. There are classes year around.

Mechanical Equipment Summary Table	
Quantity	**Equipment Description**
2	Automation Systems (Honeywell and TAC)
10	Building
124,211	Interior Square Feet
18	Air Handlers
32	VAV Boxes
1	Steam to Water Heat Exchangers
16	Hot Water Pumps
4	Chilled Water Pumps
1	Cooling Tower
1	Exhaust Fans
580	Approximate number of points for trending
380	Min Trend points
0	Loggers (excludes lighting and occupancy loggers)

This screening report is based on the PBEEEP Guidelines. It is based on one site visit, review of the facility documentation, building automation system, a limited inspection of the facility and interviews with the staff. The purpose of the screening report is to evaluate the potential of the facility for the implementation of cost-effective energy efficiency savings through recommissioning. To the best of our knowledge the information here is accurate. It provides a high level view of many of the important parameters of the mechanical equipment in the facility. Because it is the result of a limited audit survey of the facility, it may not be completely accurate or inclusive.

Building Summary Table

The following tables are based on information gathered from interviews with facility staff, a building walk-through, automation system screen-captures, and equipment documentation. The purpose of the tables is to provide the size and quantity of equipment and the level of control present in each building. It is complete and accurate to the best of our knowledge.

All Buildings State ID# E2614					
Area (sq ft)		Year Built	1968-2004	EUI/Benchmark	86.5 / 91.2
HVAC Equipment					

Air Handlers (X Total)

Description	Type	Size	Notes
AHU-3	VAV AHU	20hp	Serves Classrooms.
AHU-4	CV AHU		Serves Lecture Hall
AHU-5		10hp	Serves Library
AHU-7	VAV AHU	15hp	Serves Lab Area. Has 9 VAVs.
AHU-8	VAV AHU	15hp	Serves Chemistry and Biology. Has 7 VAVs.
Arrowhead AHU	CV AHU		Serves offices.
AHU-13	CV AHU		Serves Computer Room
Locker room AHU	CV AHU	0.5hp	Serves Locker Rooms.
Gym AHU	CV AHU	5hp	Serves Gym.
Gym Classroom AHU	CV AHU		Serves Classroom by gym.
Multi-purpose AHU	CV AHU		Serves Multipurpose room.
Student Services AHU	VAV AHU		Serves offices. Has 14 VAVs.
RTU-11	CV RTU		Serves Photo Lab
RTU-10	CV RTU		Serves Bookstore, Library, and Shipping.
RTU-12	CV RTU		Serves Mezzanine
FA-AHU-1	VAV AHU		Serves Fine Arts Auditorium.
FA-AHU-2	VAV AHU		Serves Fine Arts Classrooms. Has 6 VAVs.
FA-AHU-3	CV AHU		Serves Fine Arts Offices.

VAV Boxes (32 Total)

Description	Type	Size	Notes
14 Student Services	VAV with Reheat		
2 Child Care	VAV with Reheat		
9 Lab	VAV with Reheat		
7 Science / Biology	VAV with Reheat		

HVAC Equipment (Cont.)

Chilled Water System

Description	**Type**	**Size**	**Notes**
Chiller	Centrifugal	180 Tons	
Cooling Tower	Evapco CT	10hp fan	
Chilled Water Pumps	Constant Volume	Unknown	
Condenser Water Pumps	Constant Volume	10hp, 690 GPM	

Hot Water System

Description	**Type**	**Size**	**Notes**
Steam-to-HW Converter			
PE Pumps	CV HW Pump	(2X)	
FA Pumps	CV HW Pump	(2X)	
CC Pumps	CV HW Pump	(2X)	
AH Pumps	CV HW Pump	(2X)	
Perimeter Pump	CV HW Pump	(2X)	
Science Pumps	Variable Flow HW Pump	(2X) 7.5hp, 375GPM	Has VFD. Controlled to HW DP.
HW Loop Pumps	CV HW Pump	(2X) 7.5hp, 300GPM	Main HW Circulation Loop.
Commons Radiation Pump	CV HW Pump	(2X) 3hp, 100GPM	

Exhaust Fans (1 Total)

Description	**Type**	**Size**	**Notes**
Kitchen EF	Exhaust Fan		

Points on BAS

Air Handlers

Description	Points
AHU-3 AHU-7 AHU-8 Student Services AHU	DAT and Setpoint, RAT ,MAT, RA CO2, HTG-VLV, CHW-VLV, Reheat Valve Pos, HWST, CHWST, OAD Pos, Min OAD Pos, DSP and Setpoint, SF-S and Speed, EF-S (2X), EF Damper Pos (2X)
AHU-4 AHU-5	DAT and Setpoint, MAT and Setpoint, OAT, OA Damper Pos and Min Pos, HTG-VLV, CHW-VLV, Reheat Valve Pos, HWST, CHWST, SF-S and Amps, EF-S
AHU-13	DAT and Setpoint, MAT and Setpoint, OAT, OA Damper Pos and Min Pos, HTG-VLV, CHW-VLV, Reheat Valve Pos, HWST, CHWST,
Arrowhead AHU Multi-purpose AHU Locker room AHU Gym AHU Gym Classroom AHU	OAT, MAT, DAT, RAT, OA Damper Pos, Coil Pump, DSP and Setpoint, SF-S, HTG-VLV, Space Temp and Day and Night Setpoint
RTU-10 RTU-11	SF-S and Amp, DAT, HTG-VLV, CHW-VLV, HWST, CHWST, OAT, Economizer Damper Status, Space Temp and Setpoint,
RTU-12	Assumed to be the same as RTU 10 and 11.
FA-AHU-1 FA-AHU-2	DAT and Setpoint, MAT, RAT, RA-RH, RA-Enth, Heating Valve Pos, Cooling Output, RA Damper Pos, Relief Damper Pos, OA Damper Pos and Min Pos, Economizer Lockout, OA-Enth, OA Flow and Setpoint, Space Temp, Supply Air Flow, SF-S, Speed, and Amps
FA-AHU-3	DAT and Setpoint, MAT, RAT, RA-RH, RA-Enth, Heating Valve Pos, Cooling Output, RA Damper Pos, Relief Damper Pos, OA Damper Pos and Min Pos, Economizer Lockout, OA-Enth, OA Flow and Setpoint, Space Temp, SF-S and Amps

VAV Boxes

Description	Points
101-114	Space Temp and Setpoint, Actual CFM, Reheat Valve Pos, Radiation Valve Pos, VAV DAT

Heating System

Description	Points
PE & FA HW	PE: HWP-1 and -2 Status and Amps, HWST, HWRT, FA: HWP-1 and -2 Status and Amps
Science HW	HPW Status and Speed, DP
CC &AH HW	CC:HWP-1 and -2 Status and Amps, HWST (common), HWRT AH: HWP-1 and -2 Status and Amps, HWRT
Perimeter Radiation	HWP-1 and -2 Status
Commons Radiation	HWP-1 and -2 Status
Main HW Loop	HWP-1 and -2 Status
HW Converter	Steam Pressure, New Temp, Old Temp

PBEEEP Abbreviation Descriptions			
AHU	Air Handling Unit	HUH	Horizontal Unit Heater
BAS	Building Automation System	HRU	Heat Recovery Unit
CD	Cold Deck	HW	Hot Water
CDW	Condenser Water	HWDP	Hot Water Differential Pressure
CDWRT	Condenser Water Return Temperature	HWP	Hot Water Pump
CDWST	Condenser Water Supply Temp	HWRT	Hot Water Return Temperature
CFM	Cubic Feet per Minute	HWST	Hot Water Supply Temperature
CHW	Chilled Water	HX	Heat Exchanger
CHWRT	Chilled Water Return Temperature	kW	Kilowatt
CHWDP	Chilled Water Differential Pressure	kWh	Kilowatt-hour
CHWP	Chilled Water Pump	MA	Mixed Air
CHWST	Chilled Water Supply Temperature	MA Enth	Mixed Air Enthalpy
CRAC	Computer Room Air Conditioner	MARH	Mixed Air Relative Humidity
CUH	Cabinet Unit Heater	MAT	Mixed Air Temperature
CV	Constant Volume	MAU	Make-up Air Unit
DA	Discharge Air	OA	Outside Air
DA Enth	Discharge Air Enthalpy	OA Enth	Outside Air Enthalpy
DARH	Discharge Air Relative Humidity	OARH	Outside Air Relative Humidity
DAT	Discharge Air Temperature	OAT	Outside Air Temperature
DDC	Direct Digital Control	Occ	Occupied
DP	Differential Pressure	PTAC	Packaged Terminal Air Conditioner
DSP	Duct Static Pressure	RA	Return Air
DX	Direct Expansion	RA Enth	Return Air Enthalpy
EA	Exhaust Air	RARH	Return Air Relative Humidity
EAT	Exhaust Air Temperature	RAT	Return Air Temperature
Econ	Economizer	RF	Return Fan
EF	Exhaust Fan	RH	Relative Humidity
Enth	Enthalpy	RTU	Rooftop Unit
ERU	Energy Recovery Unit	SF	Supply Fan
FCU	Fan Coil Unit	Unocc	Unoccupied
FPVAV	Fan Powered VAV	UH	Unit Heater
FTR	Fin Tube Radiation	VAV	Variable Air Volume
GPM	Gallons per Minute	VFD	Variable Frequency Drive
HD	Hot Deck	VIGV	Variable Inlet Guide Vanes
HP	Horsepower	VUH	Vertical Unit Heater

Conversions:
1 kWh = 3.412 kBtu
1 Therm = 100 kBtu
1 kBtu/hr = 1 MBH